AIRS/AMSU/HSB Version 5 Retrieval Flow

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INTRODUCTION TO V5 RETRIEVAL FLOW

All quantities marked **best** (associated quality factor = 0) and almost all quantities marked **good** (associated quality factor = 1) have passed through the entire retrieval system. It may be helpful to some users to understand the processing paths by which termination of the V5 retrieval process can occur. The steps are single-path sequential for V5, but early termination occurs when something fails along the way. There are seven possibilities, listed below.

- Retrievals falling into case 7 are considered to be successful MW/IR retrievals. Products should be used or avoided as indicated by their individual quality flags. The user is encouraged to read **V5_L2_Quality_Control_and_Error_Estimation.pdf,** which describes the individual quality flags.
- Retrievals falling into case 1 should not be used for any purpose.
- Retrievals falling into case 3 contain only microwave products.
- We recommend using only cloud products and OLR products from retrievals falling into cases 2, 4, 5 and 6, along with the cloud products falling into case 7.

1. MW retrieval fails (i.e., temperature profile is rejected), cloudy regression succeeds (or fails), and the first cloud parameter retrieval fails. All output is considered **bad** (associated quality factors set to 2) and most products contain only flag values. We estimate 1% of retrievals are in this subset.
2. MW retrieval fails, but cloudy regression succeeds and first cloud parameter retrieval succeeds. In this case we attempt to continue only through this first cloud parameter retrieval and then terminate (there is no trusted MW emissivity.) Clouds and OLR are output with associated quality flags set to 1; all other quantities are output with associated quality flags set to 2. We estimate 1% of retrievals are in this subset.
3. MW retrieval succeeds, but failure occurs before the end of the first cloud parameter retrieval. MW products are marked as described in **V5_L2_Standard_Product_QuickStart.pdf**. All other products are unusable and marked bad (associated quality flags set to 2). We estimate 1% of retrievals are in this subset.
4. MW retrieval succeeds, first cloud parameter retrieval succeeds, but failure occurs before final temperature retrieval. The state at the end of the first cloud parameter retrieval (the "fallback state") is output, with clouds and OLR associated quality flags set to 1 and all other parameters associated quality flags set to 2. We estimate 2% of retrievals are in this subset.
5. All steps succeed through final temperature retrieval, but failure occurs in CO or CH4 retrieval. CO and CH4 are marked bad (associated quality flags set to 2), but other states are marked as in (6) or (7) below. This situation is not known to occur.

6. All steps execute, but the case is determined to be at least 90% cloudy. The final retrieval is judged to be inferior to the state at the end of the first cloud parameter retrieval, and the fallback state is output. The quality factors for cloud products and OLR are set to 1 and all other quality factors set to 2. We estimate 5% of retrievals are in this subset.

7. All steps execute and the case is determined to be less than 90% cloudy. The quality factors for cloud products and OLR are set to 0. Quality control is applied to other parameters as described in the document, **V5_L2_Quality_Control_and_Error_Estimation.pdf**. We estimate 90% of retrievals are in this subset.

A step-by-step comparison of V4 and V5 retrieval flow follows.

COMPARISON OF V4 AND V5 RETRIEVAL FLOWS

Version 4	Version 5	Ver 5 AIRS-Only
MW-Only Retrieval X^{CLIM}, $R_{MW} \Rightarrow X^{MW}$, $(\varepsilon_{MW}, q_{liq}, C_s)$	**MW-Only Retrieval** X^{CLIM}, $R_{MW} \Rightarrow X^{MW}$, $(\varepsilon_{MW}, q_{liq}, C_s)$	
N/A	**Cloudy Regression** R_{MW}, $R_{IR} \Rightarrow X^{CR}$	**Cloudy Regression** $R_{IR} \Rightarrow X^{CR}$
AMSU Retrieval R_{MW}, $X^{MW} \Rightarrow X^0$ (update T, T_s, q)	**AMSU Retrieval** R_{MW}, $X^{CR} \Rightarrow X^0$ (update T, T_s, q)	set $X^0 = X^{CR}$
Cloud Parm Ret 1 α^0, P_c^0	**Cloud Parm Ret 1** α^0, P_c^0	**Cloud Parm Ret 1** α^0, P_c^0
1st Cloud Clearing R_{IR}, $X^0 \rightarrow \hat{R}_{IR}^0$	**1st Cloud Clearing** R_{IR}, $X^0 \rightarrow \hat{R}_{IR}^0$	**1st Cloud Clearing** R_{IR}, $X^0 \rightarrow \hat{R}_{IR}^0$
Regression $\hat{R}_{IR}^0 \rightarrow X^{REG}$ $(T, T_s, q, O_3, \varepsilon_{IR})$	**Regression** $\hat{R}_{IR}^0 \rightarrow X^{REG}$ $(T, T_s, q, \varepsilon_{IR})$	**Regression** $\hat{R}_{IR}^0 \rightarrow X^{REG}$ $(T, T_s, q, \varepsilon_{IR})$
AMSU Retrieval R_{MW}, $X^{REG} \Rightarrow X^1 X^1$ (update T, ε_{MW})	**AMSU Retrieval** R_{MW}, $X^{REG} \Rightarrow X^1$ (update T, T_s, ε_{MW})	
Cloud Parm Ret 2 α^1, P_c^1	**Cloud Parm Ret 2** α^1, P_c^1	**Cloud Parm Ret 2** α^1, P_c^1
(continued next page)	**(continued next page)**	**(continued next page)**

Version 4	Version 5	Ver 5 AIRS-Only
2nd Cloud Clearing R_{IR} , $X^1 \rightarrow \hat{R}_{IR}^1$	**2nd Cloud Clearing** R_{IR} , $X^1 \rightarrow \hat{R}_{IR}^1$	**2nd Cloud Clearing** R_{IR} , $X^{REG} \rightarrow \hat{R}_{IR}^1$
Physical Retrieval R_{MW} , R_{IR} , $X^1 \Rightarrow T_s$	N/A	N/A
AMSU Retrieval R_{MW} , X^1, $T_s \Rightarrow X^2$ (update T, ε_{MW})	N/A	N/A
Cloud Parm Ret 3 α^2, P_c^2	N/A	N/A
3rd Cloud Clearing R_{IR} , $X^2 \rightarrow \hat{R}_{IR}^2$	N/A	N/A
Physical Retrieval X^2 , $\hat{R}_{IR}^2 \Rightarrow X^{PHYS}$ (T_s, ε_{IR}, T, q, O_3)	**Physical Retrieval** X^1 , $\hat{R}_{IR}^1 \Rightarrow X^{PHYS}$ (T_s, ε_{IR}, T, q, O_3)	**Physical Retrieval** X^1 , $\hat{R}_{IR}^1 \Rightarrow X^{PHYS}$ (T_s, ε_{IR}, T, q, O_3)
AMSU Retrieval R_{MW} , $X^{PHYS} \Rightarrow X^{test}$ (update T, ε_{MW})	**AMSU Retrieval** R_{MW} , $X^{PHYS} \Rightarrow X^{test}$ (for quality control)	**N/A**
Cloud Parm Ret 4 α^3, P_c^3	**Cloud Parm Ret 3** α^2, P_c^2	**Cloud Parm Ret 3** α^2, P_c^2
4th Cloud Clearing R_{IR} , $X^{test} \rightarrow \hat{R}_{IR}^3$	**3rd Cloud Clearing** R_{IR} , $X^{PHYS} \rightarrow \hat{R}_{IR}^2$	**3rd Cloud Clearing** R_{IR} , $X^{PHYS} \rightarrow \hat{R}_{IR}^2$
Physical Retrieval X^{test} , $\hat{R}_{IR}^3 \Rightarrow X^{final}$ (T_s, ε_{IR}, T, CO)	**Physical Retrieval** X^1, X^{PHYS} , $\hat{R}_{IR}^2 \Rightarrow X^{final}$ (T_s, ε_{IR}, T, CO, CH_4)	**Physical Retrieval** X^1, X^{PHYS} , $\hat{R}_{IR}^2 \Rightarrow X^{final}$ (T_s, ε_{IR}, T, CO, CH_4)
Choose Final State $X^{OUT} = X^0$ or X^{final}	**Choose Final State** $X^{OUT} = X^0$ or X^{final}	**Choose Final State** $X^{OUT} = X^0$ or X^{final}
$X^{OUT} \rightarrow$ OLR	$X^{OUT} \rightarrow$ OLR	$X^{OUT} \rightarrow$ OLR
	Error Estimates δX	**Error Estimates** δX
Quality Control	**Quality Control**	**Quality Control**

NOTATION

Atmospheric States

$\mathbf{X}^{CLIM}$ climatology atmospheric state, with the addition of the AVN surface pressure derived from the 3, 6 and 9 hour forecasts.

$\mathbf{X}^{MW}$ atmospheric state derived by MW-Only Retrieval (product)

$\mathbf{X}^{CR}$ atmospheric state derived by Cloudy Regression

$\mathbf{X}^{REG}$ atmospheric state derived by Regression

$\mathbf{X}^{PHY}$ atmospheric state derived by Physical Retrieval

$\mathbf{X}^{n}$ n^{th} atmospheric state

$\mathbf{X}^{test}$ derived atmospheric state used only for quality control

$\mathbf{X}^{final}$ final atmospheric state derived by physical retrieval algorithm

$\mathbf{X}^{OUT}$ atmospheric state reported as product

$\delta\mathbf{X}$ error estimate for atmospheric state product

Note: The climatology atmospheric state is the NCEP 20-year temperature ($T(p)$) and moisture ($q(p)$) daily mean reanalysis on a 2-degree grid, extended above 100-mb by a UARS climatology and interpolated to the AIRS pressure levels.

Operations

$\mathbf{X}^{a} \Rightarrow \mathbf{X}^{b}$ retrieval of atmospheric state "b" starting from state "a"

$\mathbf{X}^{c} \rightarrow \hat{\mathbf{R}}_{i}^{c}$ derivation of parameter(s) from atmospheric state "c"

Physical Parameters

$\mathbf{R_{MW}}$ observed MW radiances

$\mathbf{R_{IR}}$ observed (cloudy) IR radiances

$\mathbf{\hat{R}_{IR}^{c}}$ cloud cleared IR radiances derived from atmospheric state "c"

$\mathbf{\alpha^{n}}$ cloud fraction, iteration "n"

$\mathbf{P_{c}^{n}}$ cloud top pressure, iteration "n"

$\mathbf{q_{liq}}$,   liquid water content from MW-Only Retrieval

$\mathbf{C_{s}}$ surface classification from MW-Only Retrieval

$\mathbf{\varepsilon_{MW}}$ surface emissivity from MW-Only Retrieval

$\mathbf{T_{s}}$ surface skin temperature

OLR   outgoing longwave radiation product

T   Tair profile product

q   precipitable water vapor profile/burden product

$\mathbf{O_3}$ ozone profile/burden product

CO   carbon monoxide profile/burden product

$\mathbf{CH_4}$ methane profile/burden product

(a, b, c)   retrieve physical parameters a, b, c

(update a, b, c)   update previously retrieved parameters a,b,c